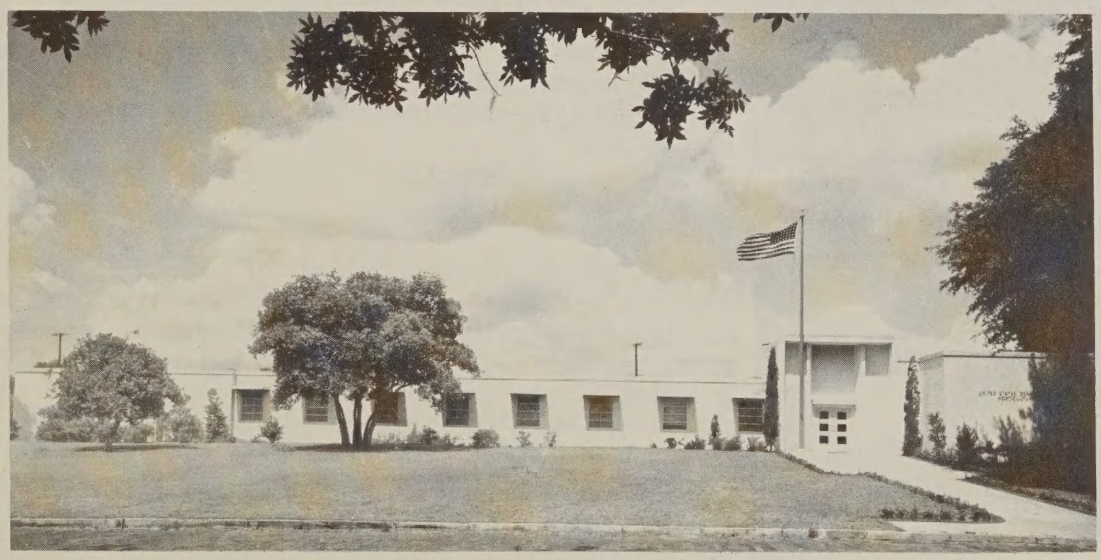


U. S. HORTICULTURAL FIELD STATION - AGRICULTURAL RESEARCH SERVICE

2120 Camden Road, Orlando, Florida

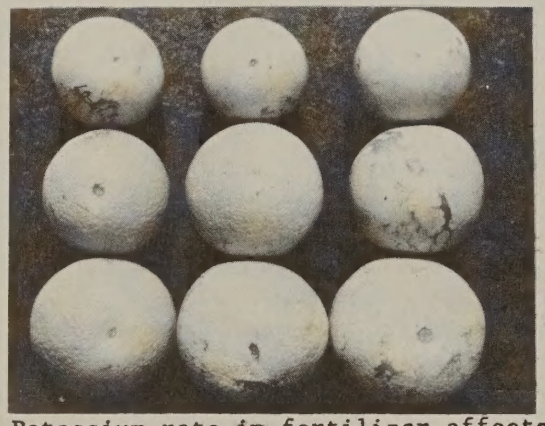
This facility is devoted primarily to research on problems in citrus culture. The Station was founded in 1892 at Eustis, Florida, in response to growers' pleas for help on the problems of "blight" and "dieback" which threatened the industry. From the original start on disease problems, the programs of research have expanded gradually to include variety improvement, rootstock, mineral nutrition, cold hardiness, hormones, insects, nematodes, and quality preservation of fresh fruit. Each project is designed to supplement State-supported research, especially on problems of long duration or of great interest to several states.

Easy peeling characteristic of new fresh fruit varieties

VARIETIES.--For centuries a few of the 1000 or so native forms of citrus were cultivated by man. Cross breeding as a way of producing desirable types was pioneered by the USDA just prior to 1900 and intensive research still continues. Many new hybrids have been tested and a few have become commercial varieties of esteemed quality. Breeding is difficult because most desirable types produce few hybrids when attempts are made to cross pollinate them. Scientists now know how to select parents that give many hybrids, thus increasing the chances of developing even better varieties. Disease resistance and cold hardiness are also being bred into citrus.

7-year-old Valencia orange trees showing size control by rootstock

ROOTSTOCKS.--Nearly all commercial citrus trees are propagated by budding onto selected kinds of root systems called rootstocks. The rootstock is very important for it can determine the adaptability of the trees for various soil types and thereby influence the growth and fruitfulness. Different varieties of citrus show a distinct preference for certain rootstocks and growers must also consider this in planning a citrus orchard. Disease resistance is also of paramount importance in a good stock. Rootstock research is a continuing process of selection, breeding, and testing of hundreds of new varieties as stocks for controlled tree size, fruitfulness and fruit quality, cold hardiness, and resistance to disease and nematodes.



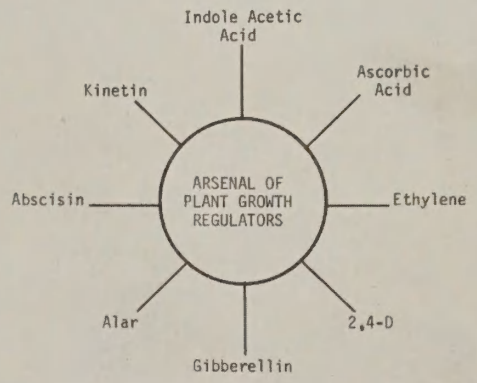
Potassium rate in fertilizer affects size of Valencia oranges

FERTILIZATION.--Growing citrus on Florida's light sandy soils requires regular fertilization. In addition to N-P-K, numerous trace elements must also be supplied. Magnesium, copper, zinc, boron, iron, manganese and molybdenum all find a place in maintaining vigorous and productive trees. Fertilization has always been the biggest production cost item for growers. Research has saved growers several million dollars annually through the development of fertilizer programs based on fewer applications, cheaper sources, more concentrated materials, and elimination of mineral deficiencies. A modern grove is fertilized by one man applying high grade chemicals with a bulk spreader. Research continues to seek long-lasting and more effective materials.

Freezing weather can cause severe damage in unprotected groves

COLD PROTECTION.--Temperatures of 20° F or lower can be expected about every 10 years in Florida. The freeze damage to citrus can be disastrous to growers. In December 1962, a freeze killed one-fourth of the State's 52 million trees and caused an initial loss of $500 million. Research is attempting in several ways to minimize the devastating effects of future freezes. In addition to seeking varieties that are more tolerant of freezing weather, new chemicals are being used to increase the cold hardiness of trees. New methods of heating, using electrical and fuel sources, are being tried in order to make cold protection more efficient and practical.

HORMONES.--The use of chemical growth regulators in citrus has been limited thus far. The possibility of applying basic knowledge of plant hormones to such problems as setting of young fruit, control of fruit size and quality, abscission of ripe fruit, and control of tree growth and dormancy is challenging. The industry urgently needs practical chemical control of fruit abscission as an aid in mechanical harvesting of enormous crops. Research is being conducted on all of these lines of work with emphasis on abscission control in relation to harvest.

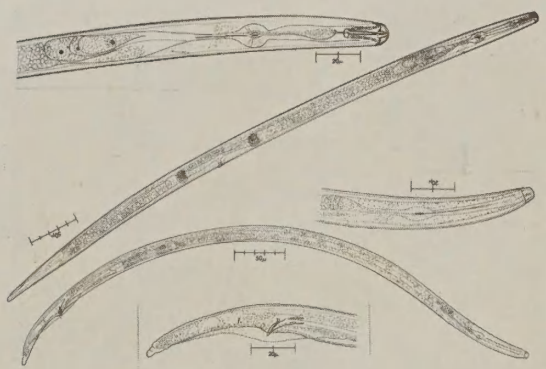


Some of the chemicals that affect growth and fruit characteristics

INSECTS.--Insect control is very costly in most fruit crops. Various methods are being studied for control of insects and mites attacking citrus and subtropical fruits. Chemicals are evaluated for effectiveness against pests as well as their influence on organisms beneficial to biological balance. Predators, parasites, and pathogens of foreign origin are introduced for biological control studies. Attractants and baits are tested to develop materials useful in early detection of pests, such as fruit flies. Insect transmission of viruses also is being studied under laboratory and grove conditions.

Rust mite control is necessary for the production of bright fruit

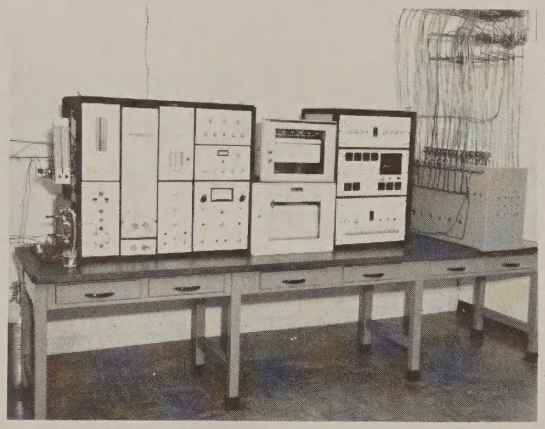
NEMATODES.--Some serious diseases of plants are caused by nematodes, which are tiny worm-like animals. These "worms" are not visible without magnification. They cause damage by feeding on roots. Spreading decline, attributed to the "burrowing" nematode, has been found in several thousand acres of citrus in the central part of the state. Trees in all regions of the state are infested with other kinds of nematodes, such as "citrus" and "lesion". Research is attempting to develop practical methods of using chemicals to kill nematodes in established groves in order to improve tree growth and to increase yield of fruit. For use in new plantings, rootstocks resistant to nematodes are being tested.



Burrowing nematodes are only about one-fiftieth of an inch long

DISEASE.--Citrus trees are subject to diseases caused by bacteria, fungi, and viruses. Heavy economic losses result from trees being weakened or killed. Research has developed practical chemical control for most bacterial and fungal diseases. Foot-rot, a disease of trunk and roots, is not easily controlled by fungicides. Viruses are unaffected by known chemical treatment. Some viruses can be avoided by using virus-free budwood. Other viruses are carried from tree to tree by insects and cannot be controlled, except by using tolerant varieties. Research is continuing on how viruses are transmitted, elimination of viruses from budwood by heat therapy, and selection of varieties that are tolerant to viruses and fungi.

Psorosis virus causes bark disease of trunks and limbs



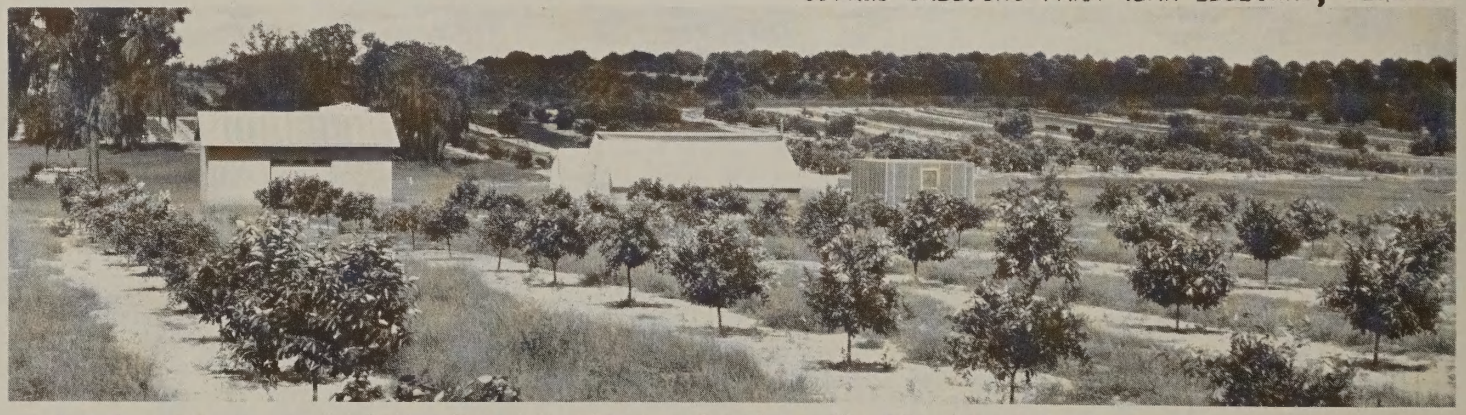
Equipment for continuous measurement of atmosphere during fruit storage

QUALITY MAINTENANCE.--Marketing of citrus, like other produce, is dependent on maintaining the best possible quality until consumed. Proper storage and transportation conditions are important not merely to prevent decay but also to prevent changes in taste. Lengthy storage is desirable in order to stretch the marketing season of top quality fresh fruit. Researchers are continually studying combined effects of temperature, humidity, and controlled gases (nitrogen, oxygen, and carbon dioxide) on the keeping life of citrus. Work is also done on electronically controlled grading and sorting devices with the objective of finding ways to select uniform high quality fruit.

Serious rotting of fruit can result from poor handling practices

FRUIT DISEASES.--Twenty percent of all fruits and vegetables is lost through spoilage in market channels. Citrus grown in humid climates is more prone to rot from fungal infection than fruit from a dry climate. Methods of reducing decay by refrigeration and chemical agents have been studied at this station for many years and industry practices are constantly improved as a result. The search is difficult because most fungicides either damage the fruit or are unsafe to humans. Hundreds of chemicals have been tested in the continual hunt for safer and more effective agents. Flash heating in "hot" water is one of the new methods found to reduce fruit decay.

CITRUS BREEDING FARM NEAR LEESBURG, FLORIDA



U.S.D.A. citrus research has been greatly assisted by the Florida industry. A large tract of land near Leesburg was purchased by The Citrus Research Foundation as a breeding station in 1959. The Foundation, a non-profit corporation, is composed of both citrus organizations and individual growers. Over 50 thousand hybrid citrus seedlings are being fruited out (above) in the search for improved varieties that combine high quality, disease resistance, and cold hardiness. A portion of the farm is planted to a collection of several hundred named varieties, or specimens from around the world, that serve as parents for hybridization.

Some idea of the range in fruit size and shape resulting from crossing is shown at the right. A Temple orange was hand pollinated with pollen of Orlando tangelo. Several years later, after the seeds had grown into trees, each tree produced a different type of fruit.